

Work Plan

238714



Remedial Design Combe Fill South Landfill

State of New Jersey
Department of Environmental Protection

November 1988



O'BRIEN & GERE

WORK PLAN
REMEDIAL DESIGN - COMBE FILL SOUTH LANDFILL

NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION

NOVEMBER 1988

O'Brien & Gere Engineers, Inc.
Raritan Plaza I
Edison, New Jersey 08837

Combe Fill South Landfill
Remedial Design

Work Plan

Table of Contents

<u>Section 1 - Introduction</u>	<u>Page</u>
1.01 General	1-1
1.02 Site Description	1-1
1.03 Work Plan Description	1-1
 <u>Section 2 - Scope of Work</u>	
2.01 General	2-1
2.02 Field Sampling and Testing Plan (10.1.3.1)	2-1
2.03 Interim Environmental Monitoring Plan (10.1.3.2)	2-1
2.04 Health and Safety Plan (10.1.4)	2-1
2.05 Quality Assessment Project Plan (10.1.5)	2-2
2.06 Implement Field Testing (10.2.1)	2-3
2.07 Interim Environmental Monitoring (10.2.2)	2-5
2.08 Treatability Testing (10.2.1.2)	2-5
2.09 Preliminary Design (10.3)	2-5
2.10 Final Design (10.4)	2-7
2.11 Final Engineering Drawings (10.4.3)	2-7
2.12 Construction Specifications (10.4.4)	2-8
2.13 Construction Operating Plan (10.4.5)	2-8
2.14 Construction Bid Package (10.4.7)	2-8
2.15 Property and Field Surveys (10.5)	2-9
2.16 Bid Assistance (10.6)	2-9
 <u>Section 3 - Project Organization</u>	
3.01 Organization	3-1
 <u>Section 4 - Project Progress Schedule</u>	
4.01 General	4-1
4.02 Proposed Schedule	4-1
 <u>Figure</u>	
1 - Organization Chart	
2 - Project Progress Schedule	
 Appendix 1 - Treatability Testing	

SECTION 1 - INTRODUCTION

1.01 General

The purpose of this Work Plan for the Remedial Design of the Combe Fill South Landfill is to provide the New Jersey Department of Environmental Protection (NJDEP) with a document describing the approach to be utilized in the design efforts. Additionally, the proposed Project Progress Schedule is provided for utilization in tracking the status of the project through all phases of the design. The Work Plan and Schedule were developed following completion of the file review and reflect changes which were identified as more information relative to the project was obtained. This Work Plan is revised to reflect NJDEP/EPA comments on the other plan and also presents the revised schedule.

1.02 Site Description

The Combe Fill South Landfill site is located in Chester and Washington Townships, Morris County, New Jersey approximately twenty (20) miles west of Morristown. This inactive municipal landfill consists of three (3) separate disposal areas covering about sixty-five (65) acres. Existing cover at the site is poor and consists of coarse and permeable local soils and crushed rock. A shallow aquifer exists at the site within the saprolite layer, saturating much of the waste. A deeper aquifer exists within the fractured bedrock. This deep aquifer is the major source of potable water in the vicinity of the landfill. However, local ground water wells often tap into the interface between the saprolite and the bedrock.

Approximately 5,000,000 cubic yards of waste material are buried within the Combe Fill South Landfill. The majority of the waste reportedly includes typical household waste and non-hazardous industrial waste. Hazardous materials were not found within the landfill during the RI/FS program. However, the presence of volatile organic compounds has been identified within both the shallow and deep aquifer. This contamination has been noted within the nearby potable residential wells while the wells downgradient of the site have been identified at risk due to ground water migration.

The Record of Decision for this site has identified the following areas to be encompassed within the Remedial Design:

- Alternative water supply (not included within this Remedial Design);
- Active gas collection/treatment system;
- Expanded environmental monitoring;
- A multi-layered terraced cap;
- A shallow ground water recovery and on-site treatment system;
- Surface water controls; and
- Security fencing.

1.03 Work Plan Description

This Work Plan provides a description of the work to be conducted for the Remedial Design as well as a proposed Project Progress Schedule. Section 2 of the Work Plan describes each of the specific work tasks with reference to the task numbering system outlined within the Request for Proposal (RFP). Section 2 provides a description of the personnel organization proposed to conduct the work and Section 3 provides the proposed schedule.

SECTION 2 - SCOPE OF WORK

2.01 General

This section provides a description of each of the activities to be conducted during the Remedial Design for the Combe Fill South Landfill. The descriptions provided correspond to the items on the Project Progress Schedule (Figure 1) and should be utilized while reviewing the schedule. Although the format for the Scope of Work within this Work Plan differs slightly from that of the RFP, it is presented in such a way as to facilitate the tracking of the status of the project. Task numbers corresponding to those of the RFP, have been provided to allow cross referencing to the Scope of Work section of O'Brien & Gere's proposal.

2.02 Field Sampling and Testing Plan (10.1.3.1)

A Field Sampling and Testing Plan will be developed detailing the investigations required for development of the specific design criteria for this project. These investigations include aquifer testing; fill delineation; gas testing; leachate/ground water collection; materials evaluation; and bench scale treatability studies. The plan will outline the specific methodologies, procedures and logistics of the investigatory activities. Sampling and testing protocols will be developed to conform with the guidelines of the NJDEP Procedures Manual (July 1986). The plan will be submitted to the NJDEP for review and approval prior to undertaking the field investigatory work.

Duration one (1) month. NJDEP review and finalization duration four (4) weeks.

2.03 Interim Environmental Monitoring Plan (10.1.3.2)

A plan will be developed for monitoring the environment during the Remedial Design Program. This monitoring will consist of sampling and analyzing air, ground water, surface water, and sediment at on and off-site areas to track contaminants with respect to the design criteria and potential environmental and public health effects. The Interim Environmental Monitoring Plan will provide the specific locations, types and numbers of samples and analyses to be performed as well as the specific protocols to be utilized. The Plan will be submitted to the NJDEP for review and approval prior to implementation of the sampling efforts on three (3) occasions as shown on the proposed Project Progress Schedule.

Duration one (1) month. NJDEP review and finalization duration four (4) weeks.

2.04 Health and Safety Plan (10.1.4)

O'Brien & Gere Engineers, Inc. will provide a comprehensive Health and Safety Plan (HASp) covering the full range of on-site work activities involved in the remedial design implementation. Standard procedures and requirements will be developed into site-specific protocols based on available data and information on the site and its surroundings.

Development of the site-specific HASP will involve consideration of the following:

- average weather conditions (especially temperature and relative humidity);
- number of on-site personnel;
- acclimation of on-site personnel;
- size of site and location of site with respect to road, water and telephone access; residential areas; emergency medical facilities and visibility;
- contaminants present and their speciation;
- site history; and
- job tasks and functions.

Application of the HASP would extend to all workers, on-site supervisors, regulatory agency representatives, the media, visitors, etc. Changes in working conditions or activities throughout the project would be reflected in an update of the original HASP, in order to assure the continued maintenance of adequate protection of personnel health and safety.

The HASP will be prepared by a Certified Industrial Hygienist in accordance with NJDEP, EPA and OSHA regulations and guidelines. Requirements of the current OSHA regulations as promulgated in 29 CFR 1910.120 regarding health and safety measures at hazardous waste operations will also be incorporated. The Plan will be provided in draft form to the NJDEP for review. Field activities will begin following finalization and approval of the Plan.

Duration one (1) month. NJDEP review and finalization duration four (4) weeks.

2.05 Quality Assessment Project Plan (10.1.5)

A site-specific Quality Assurance Project Plan (QAPP) will be prepared. The plan will be consistent with EPA and NJDEP guidance documents on the preparation of quality assurance project plans. The QAPP will cover all aspects of the project and will include Quality Assurance measures for design and treatability studies, as well as field and laboratory efforts.

For the Combe Fill South Landfill site, field investigation activities will be undertaken in a phased approach. Therefore, separate sampling/analysis plans will be prepared for the separate phases, including leachate sampling, soil sampling, soil gas survey, private well sampling, ground water monitoring well installation, and monitoring well sampling. Following evaluation of data resulting from each activity, subsequent phases of investigation may be proposed; therefore, an update of the QAPP will be prepared at any time during the course of the project as the need for additional field investigation is identified.

The following information specific to the Combe Fill South Landfill site will be provided in the QAPP:

1. Number of samples to be obtained from various media;
2. Number of QA/QC samples including field blanks, trip blanks and collected samples;

3. Identification of sampling locations;
4. Prioritized listing of the sequence in which samples are to be taken from the leachate, monitor wells, etc.;
5. List of critical samples for each media;
6. List of analyses;
7. Details on how samples will be transported or shipped;
8. Listing of laboratories which will receive samples for analysis;
9. Chain of custody documentation with a chain of custody form for samples taken off-site for analysis. This assures the decision maker that the analysis given is actually for the sample collected and that the sample has not been tampered with. If analysis is performed on-site, documentation of the process in field logs or other media is sufficient. Custody of samples will still be documented; however, the chain of custody form is not necessary.
10. Methods used for sampling and analyses should be generally considered valid from an engineering/scientific standpoint and be consistent with the standard analytical procedures. Methods utilized will be referenced and a statement given that protocols were followed. Any deviation from the referenced method will be documented and explained.

Preparation of the Quality Assurance Project Plan (QAPP) will be accomplished in accordance with guidelines provided by EPA QAMS-005-80 (OWRS-QA-1) to ensure that the above listed issues are addressed.

Duration one (1) month. NJDEP review and finalization duration four (4) weeks.

2.06 Implement Field Testing (10.2.1)

Upon approval of the Field Testing and Sampling Plan; the QAPP and the Health and Safety Plan, O'Brien & Gere will implement the investigatory activities to acquire the data necessary for development of the design criteria. The specifics of the investigations will be provided in the above referenced plans. A brief description of the four major activities is provided below.

a. Aquifer Testing (10.2.1.1)

A critical component in the design of the shallow ground water recovery system is the determination of the aquifer coefficients of transmissivity and specific yield. The available transmissivity data for the saprolite reflects a range of one (1) order of magnitude. This range will be refined to effectively design the recovery system. Four (4) aquifer performance tests of 48-hours each will be conducted on the saprolite aquifer. These tests will be conducted at selected sites around the landfill. Specific sites will be provided in the Field Sampling and Testing Plan. At each test site, a test well and two (2) shallow ground water observation wells will be installed. Ground water levels in all observation and monitoring wells, including the adjacent deep monitoring wells, will be monitored during the test and the subsequent recovery period. Transmissivity and specific yield values will be determined for each test using conventional time-drawdown and distance-drawdown interpretation techniques, including type curve and semi-log methods. Ground water level monitoring of the deep wells will be used to evaluate

the nature of the hydraulic connection between the shallow and deep aquifer.

Duration three (3) months.

b. Fill Delineation (10.2.14)

Along the east side of the site, the extent of the fill has not been delineated. To facilitate the design of the site cap, the extent of the fill will be determined during the investigatory program. Two (2) techniques, geophysics and test pits, will be employed to determine the extent of fill. A series of traverses perpendicular to the suspected fill boundary will be performed, using magnetometer and terrain conductivity meter surveys. Traverses will be performed at 200 foot intervals with readings taken at 20 foot intervals along each traverse. Following the geophysical surveys, test pits will be performed at selected locations to verify the results of the geophysics.

Duration one (1) month.

c. Gas Testing (10.2.1.3)

In order to provide an efficient active gas venting system design both the quality and quantity of gas being generated by decomposition of refuse in the landfill will be evaluated. To evaluate gas quality and quantity, two (2) test wells will be installed: one (1) in an older fill area, and one (1) in the newest fill. The wells will be screened from the ground water table encountered during drilling to five feet below the surface. A portable exhaustor will be used to test each well individually. The wells will be exhausted for a minimum of one week prior to collection of samples. During collection the wells will be exhausted for eight hours. In order to evaluate the quantity of gas being withdrawn from the well, a manometer will be used to periodically monitor the pressure head. Gas quality will be monitored by the collection of three (3) samples from each well, one (1) at the start of the test and then one (1) each at two hour intervals during the late morning and afternoon hours. The samples will be analyzed for percent methane; carbon dioxide (%); carbon monoxide (%); oxygen (%); nitrogen (%); TCL volatile organics; total non-methane organics; total chlorinated VOCs; hydrogen sulfide and mercaptans.

Duration two (2) months.

d. Materials Evaluation (10.2.1.5/6)

In order to insure that natural materials capable of achieving the design goals are available for use in the cap system, a literature search of existing soils information will be conducted to identify potential borrow sources within a twenty mile radius of the landfill. Sources and quantities of granular materials, low permeability soils, and topsoil will be identified. Following the identification of potential sources of materials, samples will be collected of each specific type of material; and tested for suitability in the remediation of the site. Sample numbers and tests performed will be as identified in the proposal and specified in the Field Sampling and Testing Plan.

Duration two (2) months.

2.07 Interim Environmental Monitoring (10.2.2)

During the development of design criteria, the Interim Environmental Monitoring Program prepared under TAsk 10.1.3.2 will be implemented. Samples will be collected and analyzed in accordance with the approved Interim Environmental Monitoring Plan. All data and documentation generated will be submitted to DEP for review and approval.

2.08 Treatability Testing (10.2.1.2)

The Record of Decision included a remedial approach which includes collection and treatment of ground water/leachate. The objective of this task is to specify treatment technologies and the appropriate design criteria to treat the recovered ground water/leachate to the required effluent limits. Ground water/leachate collected during the Field Sampling Program will be subjected to bench-scale laboratory pilot testing as described in the Field Sampling and Testing Plan. A description of the proposed testing methodology is provided in Appendix 1. At the conclusion of the testing program a basis of design report will be developed which summarizes the data and identified the process selection and design criteria.

Duration six (6) and one-half months.

2.09 Preliminary Design (10.3)

Upon completion of the investigatory activities, the preliminary design will be implemented. The preliminary design will include preparation of the preliminary plans in sufficient detail for review and approval by NJDEP, the preparation of a preliminary construction operations plan, a detailed and itemized cost estimate for construction of the remedial action along with the costs of supporting services for construction, and the preparation of permit applications and certifications required to obtain a State of New Jersey operation permit.

During the preliminary design, the extent of the wetlands areas which potentially affect site constraints will be defined. Upon definition, an assessment will be made as to the feasibility of not constructing within the wetlands. If this is not feasible, an environmental impact assessment will be developed for the construction activities within wetlands areas.

The landfill cover will be designed to perform in accordance with regulations and guidelines of the USEPA and the NJDEP. The final cover will be designed to:

- minimize migration of liquids through the closed landfill;
- function with minimum maintenance;
- promote drainage and minimize erosion or abrasion of the cover;
- accommodate settling or subsidence so that the integrity of the cover is maintained; and
- have permeability less than or equal to any bottom liner or natural subsoils present, and be repairable to correct settling, subsidence, erosion, etc.

The ability of the cover to minimize the migration of liquids through the closed landfill will be evaluated using the USEPA Hydrologic Evaluation of Landfill Performance (HELP) computer model. Inputs to the model include:

- monthly mean temperature;
- monthly mean solar radiation;
- precipitation data;
- leaf area index;
- type of vegetative cover;
- evaporative zone depth;
- number of layers in the cap;
- run-off curve number; and
- total area of the cover

The first three items will be obtained from a weather station nearest to the site which is contained in the existing data base for the HELP mode. The remaining inputs are either contained internally in the program, or design parameters which will be varied to meet the design goals.

The cover will be designed to function with minimum maintenance. This will be accomplished by evaluating existing site grades and comparing them to recommended minimum and maximum final grades. Where necessary, slopes will be flattened or steepened, or alternate methods of construction, such as the use of gabion retaining structures will be evaluated. Information to be used in this portion of the design will come from a review of the site topography, materials investigations, and similar experience in cover design.

In designing the cover to function with minimum maintenance, it will also be designed to promote drainage and minimize erosion or abrasion. Promotion of drainage will be achieved by installing sufficiently steep slopes and appropriately sized ditches to collect and convey runoff. The ability of cover to minimize erosion will be evaluated using the Universal Soil Loss Equation as presented in the USEPA document titled Evaluating Cover Systems for Solid and Hazardous Waste. The referenced document presents charts and tables to be used in determining input into the equation based on selected design parameters.

Laboratory test results on natural cap materials and documented properties of synthetic capping materials will be combined with available information in the literature on the engineering properties of refuse to analyze settlement due to the imposition of cap loads, fill decomposition, and consolidation as a result of fill dewatering. A computerized analysis of side slope stability will be made using the computer program "STABR" developed by J.M. Duncan and Kai Sin Wong. The program calculates factors of safety by searching for the circular slip surface having the minimum factor of safety for a given set of conditions using Bishop's Modified Method. Inputs to the program include information regarding areas to be searched, earthquake conditions, the depths of slip surfaces to be searched, the geometry, (slopes, number of sections to be analyzed, number of soil layers, the presence or absence of tension cracks, and the presence or absence of water in the tension cracks), and soil properties. This information will be generated as a result of field work, laboratory testing, literature review, and design parameters.

The cap will be designed to have a permeability less than or equal to the natural subsoils present and to be repairable to correct settling, subsidence, and erosion. Permeability of the cover will be evaluated based on the laboratory testing of natural cover materials as well as the incorporation of synthetic liners. Settling, subsidence and erosion and the ability to repair them will be evaluated as previously described.

As requested by the NJDEP, alternate access routes will be evaluated in order to determine the optimum means for providing long term service of facilities installed as part of the site remedial design. In locating the various facilities, access will be evaluated based on type of traffic needing to utilize the facilities, field conditions (slopes, wet areas, areas of dense vegetation, etc.), and the proximity of facilities to existing highways, roads and other means of access.

Additionally, during the preliminary design, O'Brien & Gere will develop a list of the necessary permits for construction and operation of the remedial design. This list will be submitted to the NJDEP for review and approval prior to initiation of development of the permit application packages. Upon verification of the permit list by the NJDEP, O'Brien & Gere will prepare the preliminary permit application packages and identify and collect additional information required to prepare the permit applications for submittal.

Upon completion, the Preliminary Design Report will be submitted to the NJDEP for review and approval prior to conducting the conceptual design.

Duration seven (7) months. NJDEP review and finalization duration four (4) weeks.

2.10 Final Design (10.4)

The Final Design task will include the preparation of the Final Design Report, engineering design and construction drawings, construction specifications, construction operations plan and the construction bid package. These documents will be prepared by O'Brien & Gere based on the review comments received by the NJDEP and US EPA on the preliminary design report and supplemental documents. The Final Design Report will include the following:

- Documentation of design criteria;
- Final design calculations;
- Final construction cost estimate;
- Final construction schedule;
- Finalization of special requirements and procedures;
- Permits package status;
- Finalization of preliminary design report documents; and
- Legal descriptions of easements to be acquired for construction.

Duration two (2) months. NJDEP review and finalization duration four (4) weeks.

2.11 Final Engineering Drawings (10.4.3)

Final Engineering Drawings will be developed concurrent with the Final Design Report. These drawings will be prepared for use in the Construction Bid

Package and will contain representations of all aspects of the design in sufficient detail to allow solicitation of competitive bids.

Duration two (2) months. NJDEP review and finalization duration four (4) weeks.

2.12 Construction Specifications (10.4.4)

Final construction specifications will be prepared based on the NJDEP/EPA review of the project specifications list prepared as part of Task 2.08. These specifications will be prepared as per the RFP guidelines. O'Brien & Gere will check and coordinate all project data prior to the submittal of the project specifications. The specifications will be presented in Construction Specification Institute (CSI) format.

Duration six (6) weeks. NJDEP review and finalization duration four (4) weeks.

2.13 Construction Operations Plan (10.4.5)

To insure that the remedial design is constructed to achieve the objectives of the remedial action in an efficient manner, a Construction Operations Plan will be developed. The plan will be developed based on the remedial design and incorporate the construction schedule to present a sequence of operations leading to successful completion of construction while providing for the health and safety of construction personnel as well as the general public.

The operations plan will be presented as a single document with separate sections tentatively titled as follows:

- Operations and Staging;
- Construction Phase Environmental Monitoring Plan;
- Construction Phase Health and Safety Measures; and
- Quality Assurance During Construction.

The Construction Operations Plan will be submitted to the NJDEP for review and approval prior to finalization.

Duration two (2) months. NJDEP review and finalization duration four (4) weeks.

2.14 Construction Bid Package (10.4.7)

Following the review and approval of the Final Design deliverables by the NJDEP, a Construction Bid Package will be developed which incorporates the following design documents:

- final design drawings;
- final construction specifications;
- final construction operations plan;
- construction schedule; and
- status of required permits.

Duration one (1) month.

2.15 Property and Field Surveys (10.5)

The Property and Field Surveys required to be completed for the Remedial Design will be conducted by Taylor, Wiseman and Taylor of Mount Laurel, New Jersey. Survey data will be incorporated into the design effort and shown on design drawings as appropriate. Two (2) phases of survey work efforts have been identified: Phase 1 - Topographic and Property Surveys, to be conducted concurrently with the task 2.05 - Field Investigatory Activities; and Phase 2 - Engineering and Easement Surveys which will be performed following review and approval of the preliminary design.

The survey work will be accomplished through the use of photogrammetric and field survey efforts. Property boundaries will be established with property corners permanently marked in the field. Additionally, sampling and testing points will be located with the survey work. Upon completion of the extent of fill investigatory work, the extent of waste fill will be field surveyed and shown on the site maps. The survey will be referenced to the State Plane Coordinate System with coordinates of all corners and permanent markers shown on the drawings. The topographic/property map will be developed at a scale of one inch (1") equals forty feet (40') with two foot (2') contour intervals.

Phase 1 - Duration three (3) months.

Phase 2 - Duration two (2) months.

2.16 Bid Assistance (10.6)

Following the preparation and review of the Construction Bid Packages, O'Brien & Gere will assist the NJDEP with the bidding phase services for the construction contracts developed under this Scope of Work. It is anticipated that one (1) contract will be issued consisting of three (3) major components: final cover/gas collection system; ground water recovery/conveyance system; and ground water treatment system. Assistance will be provided in the solicitation of bids, attendance at bid openings, bid evaluation, and the resolution of bid protests or other problems. Additionally, the design staff will be available to answer contractor questions which are directed to the NJDEP during the bidding process and to provide the technical support and documentation required to address those questions.

ORGANIZATION CHART

SECTION 3 -PROJECT ORGANIZATION

3.01 Organization

The O'Brien & Gere project organization consists of three facets: the project team which will perform the various tasks, produce project deliverables and perform the required supervision; the technical advisory committee which will provide technical overview and review services throughout the duration of the project; and subcontractors which will provide specialized technical services. O'Brien & Gere's organizational chart is presented as Figure 1.

O'Brien & Gere proposes a multifaceted project team that possesses a unique combination of experience and expertise to be encompassed within the remedial design of this site. Management and product control is provided through the project officer, project manager and the QA/QC and health and safety officer. Additionally, due to the wide diversity of technical areas encompassed within this remedial design, O'Brien & Gere has identified a technical manager for each of the primary technical components of this project. A description of the responsibilities associated with each position is provided in the following:

Project Officer: The Project Officer is responsible for the technical direction and quality control of all work performed and for assuring that all corporate responsibilities are fully carried out. Additionally, the Project Officer is responsible for discussions with the NJDEP concerning contract negotiations and for ensuring that the plan of study is adequately supported and staffed.

Project Manager: The Project Manager is responsible for providing day-to-day management and control of the project and will be the primary contact with the NJDEP. His responsibilities will include organizing and planning the work, establishing schedules and budgets for the individual tasks, working with the quality assurance officer to develop a quality assurance project plan (QAPP) and, provide the management and interface with subcontractors and arrange for the timely procurement and application of resources as necessary to complete the project. The Project Manager will also prepare all progress reports and budget maintenance and will be responsible for the technical quality of the work and reports produced.

QA/QC and Health and Safety Officer: The QA/QC and Health and Safety Officer will be fully responsible for development of the project site's specific health and safety plan and quality assurance plan. Additionally, he will be responsible for reviewing all work plans for field investigatory efforts to be conducted on site and subsequent construction related activities for compliance and conformance with the aforementioned plans.

Technical Manager: The Technical Manager for each technical component is selected and assigned to a technical area based on his experience and expertise within that area. Drawing from his experienced staff, he will be responsible for specific work plan, development and implementation of his area of expertise.

The project team will also be supported by the following subcontractors:

1. Empire Soils Investigations - Driller/Geotechnical Analysis
2. U.S. Testing Company, Inc. - Laboratory Analysis

3. Taylor, Wiseman and Taylor - Surveyor
4. OBG Operations, Inc. - Start-up and Training
5. Scott Environmental Technology, Inc. - Gas Testing

Summary descriptions of the project team members are provided below:

Project Officer: John J. Keegan, P.E. - Mr. Keegan has 22 years of experience in conducting and coordinating remedial designs and environmental assessments of hazardous waste sites and implementing other large scale design projects. Mr. Keegan has been the project officer for the design and remediation of numerous Superfund and RCRA facilities similar in scale to the Combe Fill South Landfill Remedial Design. These efforts have included the design of numerous landfill covers and/or liners for hazardous waste facilities and the design of ground water recovery and/or treatment systems at numerous sites. As Project Officer, Mr. Keegan has been responsible for budgeting, scheduling and coordinating the work efforts associated with these projects.

Project Manager: Steven J. Roland, P.E. - Mr. Roland has been with O'Brien & Gere for over nine years and has worked almost exclusively with the New Jersey hazardous waste and industrial market for the previous six years. As Project Manager, Mr. Roland has directed remedial investigation/feasibility studies and subsequent design efforts for six hazardous waste lagoons ranging in size from 2 to 21 acres. Included within these efforts was preliminary design of a 12 acre capping system in conformance with current guidelines. Mr. Roland has also directed the evaluation and design of numerous ground water recovery and/or wastewater treatment systems. Additionally, Mr. Roland is intimately familiar with New Jersey regulations through conducting over 20 environmental audits and record permit applications for facilities throughout the State of New Jersey.

QA/QC and Health and Safety Officer: Mr. Swiatoslaw W. Kaczmar, Ph.D., CIH - Dr. Kaczmar joined O'Brien & Gere in 1983 and was promoted to the position of Manager of Environmental Toxicology and Industrial Hygiene in 1986. His function is the evaluation of the toxicology and environmental disposition of chemical and physical contaminants. He performs health hazard evaluations and risk assessments on hazardous waste sites, industrial discharges, chemical emergencies and occupational exposures to determine an appropriate level of response. Dr. Kaczmar is also the Director of the Firm's toxicological testing facility and asbestos laboratory, and is a Certified Industrial Hygienist. He has performed noted research on the distribution and fate of chlorinated dioxins in Michigan and is an accomplished trace residue chemist.

Technical Managers

- A. Cap Design/Gas Collection - Mr. Richard D. Jones, P.E. - Mr. Jones has 15 years experience in the planning and design of both solid and hazardous waste management projects. Projects completed by Mr. Jones have included resource recovery systems, solid waste processing system designs, market studies for recoverable energy and materials, landfill siting studies, collection/transfer analyses, sanitary landfill designs, solid waste management facilities permitting, and hazardous waste landfill closure and remediations.

- B. Ground Water Recovery System - Mr. James T. Mickam, CPGS - Mr. Mickam has over nine years experience in hydrogeological investigations. His fields of special competence include the development, implementation and management of hydrogeologic investigations to evaluate ground water contamination occurrence and migration, and the design of municipal and industrial ground water supply wells. Hydrogeologic environmental experience includes both unconsolidated porous media and fractured bedrock flow systems.
- C. Ground Water Treatability Study - Mr. J. Kevin Farmer - Mr. Farmer has been with O'Brien & Gere for ten years. His work has primarily involved projects for industrial clients in the areas of wastewater treatability and remedial investigations. He has conducted and overseen numerous wastewater treatability studies for industrial clients throughout the country.
- D. Treatment Plant Design - Mr. Robert C. Ganley, P.E. - Mr. Ganley has been with O'Brien & Gere for thirteen years. His fields of special competence include hazardous waste site investigations and remediation, industrial wastewater treatment and pretreatment studies and design; design of municipal wastewater collection and treatment facilities; combined sewer overflow abatement studies; sewer system inspections, infiltration/inflow investigations and sewer line rehabilitation design; environmental incident and SPCC plans.
- E. Community Relations - Ms. Linda Hickok - Ms. Hickok's experience includes two years in a regulatory capacity with the NYS Department of Environmental Conservation, five years as an independent environmental consultant, and six years in environmental health regulation. Her fields of special competence include environmental regulations and permitting, solid and hazardous waste management, resource recovery, environmental impact analysis, public participation, and technical writing. She has also performed environmental assessments of over 900 projects including sanitary landfills, industrial landfills, resource recovery projects, hazardous waste storage facilities, wastewater discharges, mines, and work in or near freshwater wetlands and protected streams.
- F. Construction Management - Mr. Peter W. McMaster, P.E. - Mr. McMaster has over fifteen years of experience in construction management and contract administration. His fields of special competence include construction inspection and contract administration for wastewater treatment and collection systems, water systems, hazardous waste site remediation, municipal landfill remediation and closure, and dam and highway construction.

Technical Advisory Committee

The project manager will have the benefit of an assigned in-house technical advisory committee composed of senior technical experts who will provide technical advice and will review all material and draft reports that will be

prepared for submittal to the NJDEP. At the request of the project manager, the committee will provide advice as needed and will review and comment on each of the draft task reports with respect to technical quality, comprehensiveness, and compliance with contractual obligations of this project. A summary description of each member of the technical advisory committee is provided in the following:

Cornelius B. Murphy, Jr., Ph.D. - Dr. Murphy has directed hazardous waste management projects which include: evaluation and development of RCRA Part B permitting documentation and remediation and compliance activities for pharmaceutical, chemical processing, heavy transformer and specialty metals industries; design of hazardous waste management programs for PCB containment and treatment including drainage and sewer systems, treatment systems, and lagoon and sewer tunnel rehabilitation; design and execution of asbestos remediation program; execution of process feasibility and treatment studies for industrial rinse water recycle systems; initiation of pilot plant studies to test granular activated carbon treatment for removal of volatile organics; and design of physical/chemical treatment facilities.

Mr. Peter C. Johnson, P.E. - Mr. Johnson has been a Senior Vice President since 1978 and has been with O'Brien & Gere since 1966. He is the Administrative Officer in charge of the Firm's offices in Philadelphia, PA, Washington, DC, and Edison, NJ. His fields of special competence include hazardous and solid waste management, inspection, design and construction management for dams and related facilities, geotechnical engineering, drainage and flood studies, wastewater collection and conveyance systems, CSO facilities, wastewater treatment, and community development programs.

Mr. Steven R. Garver, P.E. - Mr. Garver joined O'Brien & Gere in 1973, became a Managing Engineer in 1978, and was promoted to Vice President of the Applied Technology Division in 1985. His fields of special competence include industrial water and waste management; process development and treatability research; hazardous wastes; biological treatment; water and waste chemistry; environmental regulations. He has managed projects involving industrial surveys, process development, facility designs and environmental programs, Operation and Maintenance Manuals and operating assistance for industries which produce organic and inorganic chemicals, pharmaceuticals, fertilizers, explosives, oil refining, paper products, photo processing, food goods, fermentation products, electrical and electronic equipment, metal finishing, steel and specialty metals, automotive and aircraft parts.

Mr. Richard L. Elander, P.E. - Mr. Elander joined O'Brien & Gere in 1960 and has held a number of positions in engineering design and construction inspection. He was promoted to Contract Administrator in 1973 and in that position, coordinated the activities of contractors and inspectors involved with the construction of numerous wastewater conveyance and treatment facilities; solid waste milling facilities; and electric distribution systems. Promoted to Vice President of the Construction Division in 1982, Mr. Elander has assumed overall responsibility for services related to construction of water and wastewater facilities, hazardous waste site remediation, and industrial facilities.

PROJECT PROGRESS SCHEDULE

SECTION 4 - PROJECT PROGRESS SCHEDULE

4.01 General

The Project Progress Schedule developed with this Work Plan is intended to be used as a tracking device to assist in checking the status of the various components of this program. It provides a tool for identifying the progress of the program as well as facilitating the determination of changes in the overall schedule as new data is generated which affects the original Scope of Work.

4.02 Proposed Schedule

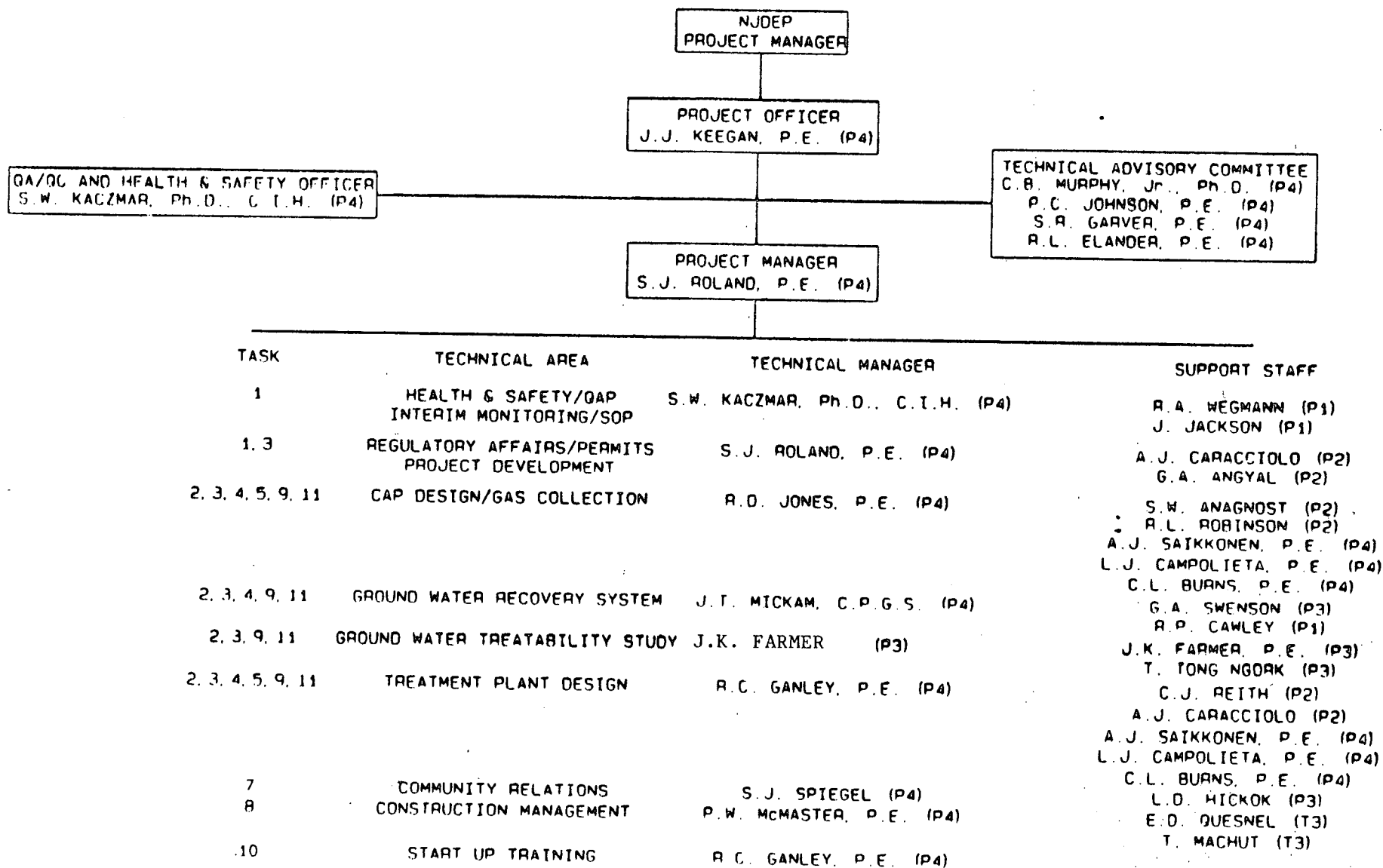
Figure 2 shows the proposed Project Progress Schedule for the Remedial Design Program for the Combe Fill South Landfill. The schedule is formatted to correspond with the work tasks presented in Section 2. Time frames within the schedule reflect the additional data which was obtained during the file review. NJDEP review and approval time within the schedule has been identified as four (4) weeks assuming an initial NJDEP review of two (2) weeks with two (2) weeks allowed for subsequent finalization and approval. Additionally, the schedule has been modified to reflect the final approval of the various work plans. Only Task Durations are shown; specific subtask schedules will be presented in the monthly report.

Figures



O'BRIEN & GERE

COMBE SOUTH LANDFILL ENGINEERING DESIGN SERVICES PROJECT ORGANIZATION

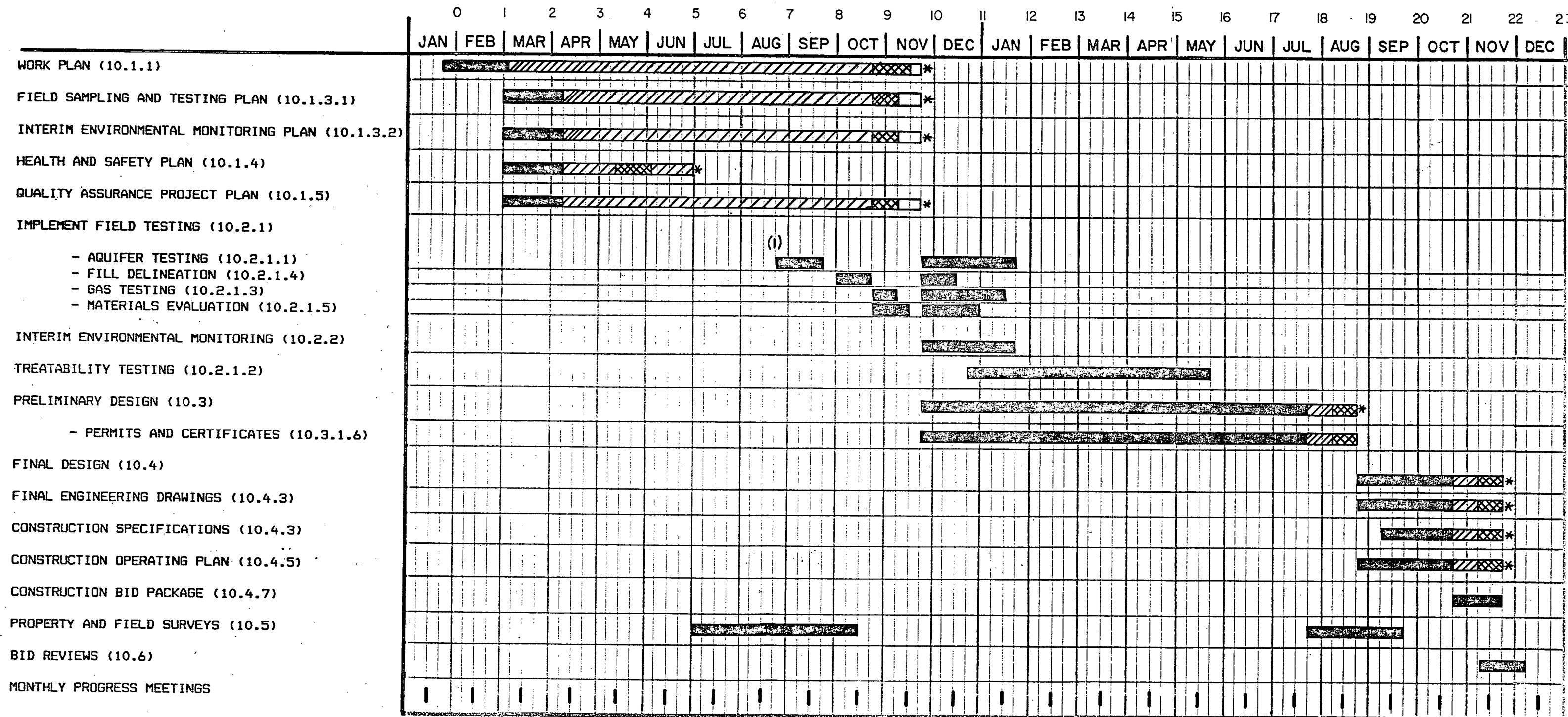


TASK SUBCONTRACTOR

2 - DRILLER/GEOTECHNICAL ANALYSIS - EMPIRE SOIL INVESTIGATIONS
 2 - LABORATORY - U.S. TESTING COMPANY, INC.
 5 - SURVEYOR - TAYLOR, WISEMAN, TAYLOR
 10 - START UP TRAINING - ORG OPERATIONS, INC.

COMBE FILL SOUTH LANDFILL
REMEDIAL DESIGN

PROJECT PROGRESS SCHEDULE



NOTES:

- [Hatched Bar] DENOTES NJDEP/EPA REVIEW
- [Cross-hatched Bar] DENOTES O'B&G FINALIZATION
- [X] DENOTES NJDEP/EPA APPROVAL

(1) PARTIAL APPROVAL OF AQUIFER TESTING (WELL INSTALLATION) RECEIVED

Appendices



O'BRIEN & GERE

APPENDIX 1
Treatability Testing

SECTION 6 - TREATABILITY STUDIES

6.01 Background

Previous studies conducted at the Combe Fill South Landfill site resulted in the definition of a remedial approach comprising collection and treatment of ground water/leachate. The economic evaluation conducted as part of the RI/FS process concluded that ground water/leachate treatment should occur on-site and discharge should be to Trout Brook below the confluence of the East and West branches. The final conceptual design report included NJDEP Draft Effluent Limitations and expected influent characteristics (see Table 1). The objective of these proposed treatability studies is to determine technologies and design conditions appropriate to treat recovered ground water to expected effluent limitations.

6.02 Wastewater Characterization

A. Ground Water/Leachate Quality Data

Ground water data were developed during the remedial investigation for six shallow wells and eight leachate seeps surrounding the fill area. Table 2 presents the range of values determined as well as the mean for specific contaminants. Evaluation of specific contaminants is important for identifying appropriate treatment technologies as the removals for volatile and semivolatile compounds can vary considerably with the specific compounds present. Based on these data some preliminary comments concerning wastewater treatment are offered:

- Raw ground water BOD-5 is relatively low (100 mg/l).
- Raw ground water total suspended solids (TSS) are quite high (480 mg/l), assuming ground water recovery wells are designed and operated properly.
- Raw ground water Total Organic Carbon (TOC) is quite high given the projected BOD-5, suggesting the presence of materials which may not be easily degraded biologically.
- Raw ground water ammonia is quite high for ground water at 50 mg/l.
- Raw ground water volatile organics are at concentrations which are regularly removed by biological treatment facilities.
- Pesticides and PCBs have not been detected in any of the ground water or leachate samples.
- Reported heavy metal concentrations are quite low and within typical guidance for biological treatment system compatibility.
- Cyanides and phenols are at concentrations where biological treatment should be effective without supplemental pretreatment.

B. Supplemental Sampling and Analyses

The aquifer performance tests, Section 2, will be used to evaluate ground water quality under conditions more closely resembling the full-scale situation with appropriately designed and developed wells. Supplemental samples of ground water from the four proposed aquifer performance wells will be collected at 24 hours and 48 hours after commencement of each aquifer performance test.

An aliquot of each sample will be filtered in the field to determine the distribution of metals and total organic carbon (TOC) between the filterable and particulate fraction. In addition, the eight samples will be analyzed for the following parameters: total phenolics, volatile organics (EPA Methods 601,602), calcium, copper, chromium, iron, lead, magnesium, nickel, zinc, BOD-5, COD, TOC, pH (field), acidity, alkalinity, conductivity (field), Total Kjeldahl Nitrogen (TKN), ammonia, nitrate-nitrite, total phosphorus, total suspended solids, total dissolved solids, sulfate, dissolved oxygen (field), PCBs/pesticides (EPA Method 608), cyanide, total and fecal coliform, beryllium, cadmium, selenium, silver, and thallium. All analyses associated with the treatability tests will be completed by U.S. Testing of Hoboken, New Jersey, an NJDEP approved, RCRA - permitted laboratory.

6.03 Preliminary Evaluation of Alternatives

A. Appropriate Unit Operations

The data presented in Table 2 indicate that treatment must provide for the removal of: BOD-5, suspended solids, TOC, ammonia, volatile organics, metals, and total phenolics. Several operations are capable of removing each of these contaminants; however, the selected approach should minimize construction and operational costs where possible.

The Conceptual Design Report (LMS 1987) suggested the following operations: equalization, chemical precipitation, biological treatment, dual media filtration, and carbon adsorption. Recent studies (1, 2) have demonstrated the cost effectiveness of using

powdered activated carbon (PAC) assisted biological treatment for contaminated ground water/leachate treatment. This technology utilizes a single reactor to perform operations previously requiring three operations: biological; filtration; and adsorption. Results of testing at Stringfellow quarry and Midstate landfill demonstrated BOD-5 removals of 85 to 90 percent and ammonia removals of greater than 99 percent (3). Data from Bofors-Nobel demonstrated ammonia reductions from 150 mg/l to less than the detection limit of 10 mg/l (1). These studies also support the removal of volatile organics by mechanisms other than air stripping within the biological reactor, and the removal of heavy metals.

Recent studies (4) have presented results which suggest that additional improvements in performance can be obtained by combining the PAC concept with the use of a sequencing batch reactor (SBR). Such a system reportedly provided excellent effluent quality, operational flexibility, and low operator attention. Data presented indicate that TOC, BOD-5 and phenol removal rates on the order of those required for this site are achievable using this technology. Based on these considerations, the bench scale testing for biological treatment will focus on SBR rather than other biological treatment processes.

It will be necessary to specifically test bench-scale versions of other biological treatment processes (e.g., activated sludge or rotating biological contactors (RBCs)), since the bench scale SBRs will adequately model potential biodegradability. Activated sludge system or RBCs could be designed based on these treatability

studies, through SBRs would probably be recommended based on cost, assuming biodegradation is readily accomplished.

Based on this evaluation, the process schematics presented on Figure 7 will be evaluated. Because information derived from bench scale tests for Alternatives A, C, and D can be used to evaluate Alternative B, no specific testing will be conducted on Alternative B. Specifically, Alternative D should simulate the metals removing capabilities of Alternative B. It is anticipated that some materials utilized and generated during the treatability testing may be disposed on-site.

6.04 Treatability Testing

Treatability testing will be conducted in the pilot study facilities within O'Brien & Gere's Syracuse office. Ground water samples will be obtained every other week by pumping from monitoring wells. Pumped ground water will be batch treated for metals removal. The resulting supernatant will be refrigerated and gradually pumped through the aerobic biological reactors. The source(s) of ground water will likely be monitoring well S-3 and/or monitoring well S-1.

A. Coagulation, Flocculation, and Sedimentation

The metal concentrations reported for shallow ground water wells are quite low relative to solubility limits for metal hydroxides as illustrated in Figure 6. Addition of iron salts with pH adjustment often results in co-precipitation of metals with the iron floc. Ferric sulfate ($\text{Fe}_2(\text{SO}_4)_3$) will be the iron salt evaluated. Jar tests will be conducted to determine the effect of pH (8.5, 9.5, 10.0) and ferric sulfate dosage (50 mg/L, 100mg/L, 200 mg/L) on

the filterable concentration of the metals. Analyses to be conducted as part of the jar test program will include TSS, pH and selected metals. When a chemical addition process has been established, a column test will be conducted to evaluate polyelectrolyte addition, settling velocities, solids generation rates, and anticipated effluent quality. The established chemical addition process will be operated on a batch basis to generate influent for the biological treatability testing. Approximately 100 gallons of chemically pretreated shallow ground water will need to be generated over the course of the biological treatment bench scale testing.

B. Biological Treatment

Three side by side reactors will be used to evaluate the performance of the alternatives. Each reactor will be operated in a fill and draw mode to simulate a sequencing batch reactor (SBR) design. Reactors A and C will receive effluent from the chemical addition pretreatment. Reactor D will receive untreated ground water. A total of approximately 150 gallons of shallow ground water will be biologically pretreated.

The three reactors will be operated at similar hydraulic retention times (24 hr.) and mean cell residence times (40 days). Powdered activated carbon (PAC dose of 125 mg/L) will be added to Reactors C and D. The three reactors will be operated for a period of approximately three months.

The PAC dosage of 125 mg/l has been selected based on known ground water characteristics and on empirical evidence. Other dosages may also prove effective. It is conceivable that a higher dosage may prove more effective. This possibility will be

evaluated during testing and dosing may be adjusted accordingly should performance be adequate. The prospect of a lower, effective dosage should be tested in the field with the full-scale system.

The analytical program will include filterable TOC, TSS, pH, and filterable ammonia as routine operating parameters on a weekly basis. Supplemental analyses for BOD-5, metals, total phenolics, and NJDEP "toxic" organics will be analyzed on a weekly basis when the systems have achieved steady state conditions.

Achievement of steady state will be determined by tracking of MLVSS levels and effluent TOC levels. Microscopic examination of biomass will be performed occasionally to qualitatively track microbial population balance, as a further means of identifying steady state conditions.

C. Polishing Filtration

Supernatant from the reactors will be analyzed for TSS to estimate a loading range on the polishing filters. A bench scale filtration test using commercially available media will be used to evaluate surface loading rates and filter performance.

Filtrate will be tested for BOD-5, TSS, TOC, pH, ammonia, metals, and phenolics. Analyses for organics (EPA 601/602) will only be conducted if these substances are present in the effluent from the bench scale biological reactors.

D. Granular Activated Carbon Adsorption

Effluent from the Alternative A polishing filter will be used to conduct a series of carbon adsorption isotherms if organics (EPA 601/602) are detected in the filtrate and/or if the TOC

concentration of the filtrate exceeds the proposed NJDEP draft monthly average TOC concentration of 10 mg/L. The isotherms will be conducted using established protocols (5). Established EPA protocols for analytical testing of organics and/or for TOC will be followed.

E. Air Stripping

Effluent from the Alternative A polishing filter will be used to perform air stripping tests with a small column packed with ceramic saddles. Influent and effluent samples will be tested by EPA Method 601 and 602 and for TOC.

F. Effluent Testing

Effluent from the wastewater treatment approach which appears to be the optimal approach during the latter part of the treatability testing program will be bioassayed (duplicate samples) to assess potential discharge toxicity.

G. Solids Handling

Each treatment alternative will generate solids requiring management. Solids generated by the treatment alternatives will be quantified. According to the Conceptual Design Report (LMS 1987) the Parsippany-Troy Hills Wastewater Treatment Plant (PTHWWTP) has excess solids handling capacity. PTHWWTP officials will be contacted to explore the option of processing Combe Fill South Landfill on-site WWTP sludge with PTHWWTP sludge in the PTHWWTP solid handling facilities. The addition of solids generated from any of the treatment alternatives to the PTHWWTP solids may affect the solids dewatering and disposal methods normally employed at the PTHWWTP.

Three composite sludge samples and a control will be prepared. Each composite sample will consist of a mixture of one particular treatment alternative's solids and PTHWWTP solids in a ratio based upon the known or expected generation rates of the two sludges. Testing will include use of chemical addition rates currently employed at the PTHWWTP, with dewaterability assessed based on filter leaf tests. The control sample will comprise only PTHWWTP solids.

To evaluate the impact of the addition of landfill related solids on disposal options, filter cake from each of the four tests will be characterized. Analyses will include heavy metals present in shallow ground water, as well as (EPA 601/602) organics.

6.05 Data Evaluation and Presentation

A treatability report will be prepared presenting the procedures and results of the testing. Included in the report will be a discussion of the results and a detailed evaluation of alternatives. The detailed evaluation will present a review of the applicability of these approaches to this type of wastewater, treatability test results, and an economic evaluation of each alternative. One alternative will be recommended and a basis of design prepared identifying major equipment items, sizes, and materials of construction.

REFERENCES

1. (Meidel and Peterson, 1987)
"The Treatment of Contaminated Groundwater and RCRA Wastewater at Bofors-Nobel, Inc.", John A. Meidel and Ronald L. Peterson, 4th National RCRA Conference on Hazardous Waste and Hazardous Materials (HMCRI), Washington, D.C., March 16-18, 1987.
2. (Meidel and Vollstedt, 1986)
"Use of Powdered Carbon to Treat Contaminated Groundwater and Leachate", John A. Meidel and Thomas J. Vollstedt, Haztech International, Denver Colorado, August 13, 1986.
3. (Zimpro, 1987)
Zimpro flyer "Landfill Leachates"
4. (Ying, et. al., 1987)
"Treatment of a Landfill Leachate in Powdered Activated Carbon Enhanced Sequencing Batch Bioreactors", Wei-chi Ying, Robert Bonk, Stanley A. Sojka, Environmental Progress, February, 1987.
5. (Dobbs, et. al., 1980)
"Carbon Adsorption Isotherms for Toxic Organics", Richard A. Dobbs and Jesse M. Cohen, EPA - 600/8-80-023.

TABLE 1
NUDEP DRAFT EFFLUENT LIMITATIONS AS COMPARED TO EXPECTED INFLUENT CHARACTERISTICS
Corte Fill South Landfill

COMPONENT	EFFLUENT LIMITATIONS	EXPECTED AVERAGE INFLUENT CHARACTERISTICS
<u>Conventional Parameters</u>		
Biochemical oxygen demand, 5 day (BOD ₅)	8.0 mg/l monthly average 12.0 mg/l weekly average 20.0 mg/l daily maximum 90% removal efficiency	100 mg/l
Total suspended solids (TSS)	8.0 mg/l monthly average 12.0 mg/l weekly average 20.0 mg/l daily maximum 85% removal efficiency	480 mg/l
Total organic carbon (TOC)	10.0 mg/l monthly average 20.0 mg/l daily maximum	510 mg/l
pH	6.5 - 8.5	7.0
Dissolved oxygen (DO)	7.0 mg/l at any time	-
Ammonia, as nitrogen (NH ₃ -N)	1.0 mg/l monthly average ^a	50 mg/l
<u>Bioassay</u>	No measurable acute toxicity	-
	95-hr LC ₅₀ < 10% mortality in all samples, including 100% treatment effluent	-
<u>Ames Test</u>	(No numerical limit for mutagenicity)	-
<u>Priority Pollutants</u>		
Volatile and semivolatile organics (NUDEP "toxic" organics)	ND or <5 ppb, for any single compound, daily maximum	300 ppb
Polychlorinated biphenyls (PCBs)	ND or <0.1 ppb, daily maximum	ND
Pesticides	ND or <1.0 ppb, daily maximum	ND
Heavy metals	ND or <50 ppb, total for all metals, daily maximum	710 ppb
Total phenolics	ND or <50 ppb, daily maximum	210 ppb
Total cyanide	ND or <20 ppb, daily maximum	24 ppb

^apossible allowances for seasonal variations not quantified.

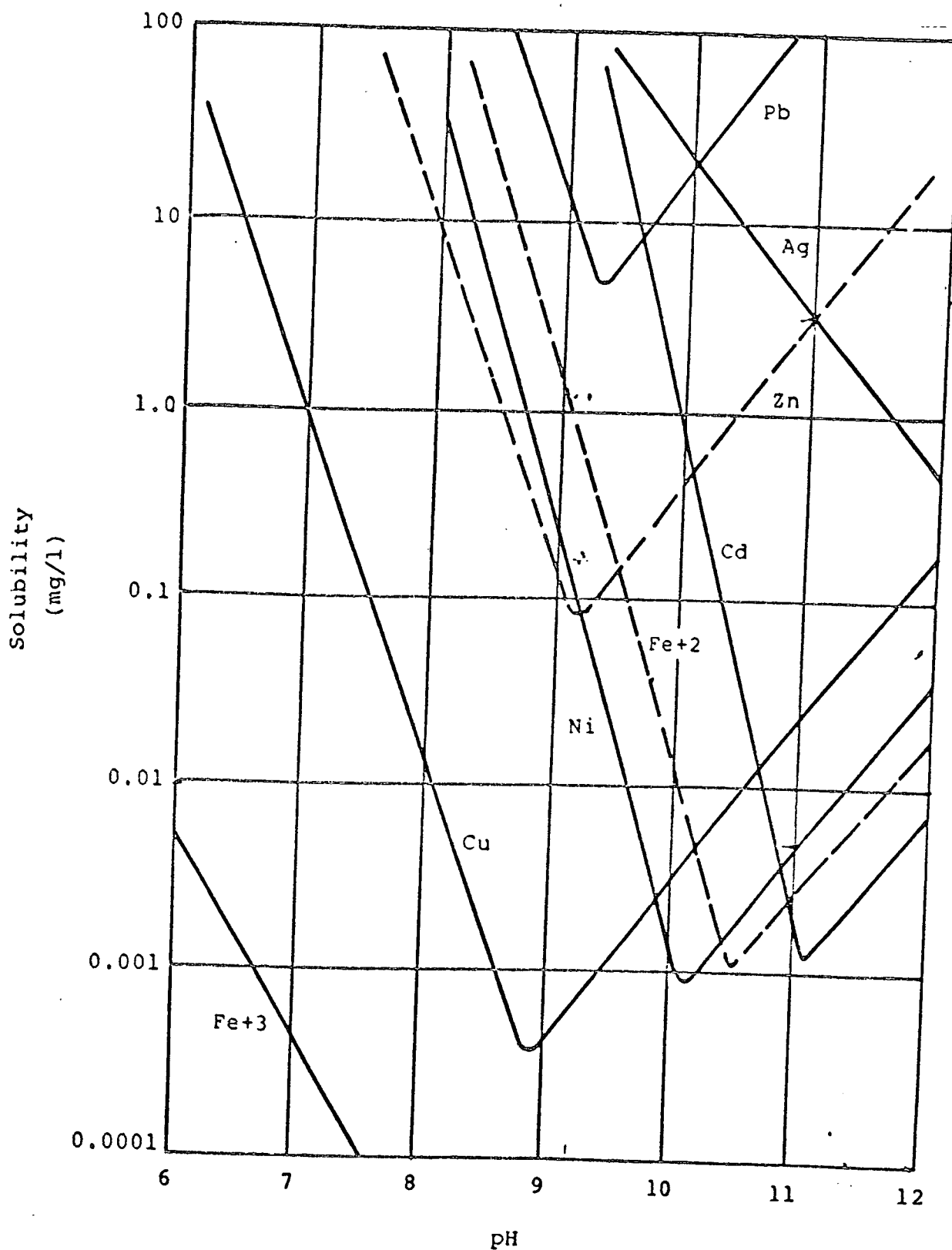
ND = not detectable.

TABLE 2
TREATABILITY TESTING
WASTEWATER CHARACTERISTICS

PARAMETER	SHALLOW GROUND WATER			LEACHATE COMPOSITE		
	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM	MEAN
<u>VOLATILES (ppb)</u>				15.0	1084.0	261.7
Benzene	0.0	80.2	26.4			
Chlorobenzene	0.0	30.3	11.6			
Chloroethane	0.0	62.0	12.0			
Chloroform	0.0	57.5	9.6			
1,1-Dichloroethane	0.0	65.2	20.2			
1,2-Dichloroethane	0.0	6.1	1.0			
1,1-Dichloroethylene	0.0	0.0	0.0			
1,2-Dichloropropane	0.0	6.0	1.0			
Ethylbenzene	0.0	7.2	1.2			
Methylene chloride	4.44	56.0	16.1			
Tetrachloroethylene	0.0	4.1	0.7			
Toluene	0.0	137.0	239.7			
Trans-1,2-dichloroethylene	0.0	8.0	1.3			
Trichloroethylene	0.0	4.0	0.7			
Vinyl Chloride	0.0	10.0	1.7			
<u>ACID/PHENOLICS (ppb)</u>				0.0	7.0	1.8
2,4-Dimethylphenol	0.0	0.0	0.0			
2-Nitrophenol	0.0	0.0	0.0			
Phenol	0.0	1.5	0.3			
<u>BASE/NEUTRALS (ppb)</u>				2.0	71.0	34.5
Bis(2-chloroethyl)ether	0.0	5.8	1.8			
Bis(2-ethylhexyl)phthalate	0.0	11.0	3.5			
1,2-Dichlorobenzene	0.0	9.77	2.8			
1,4-Dichlorobenzene	0.0	39.4	8.3			

TABLE 2 (CONT'D.)
TREATABILITY TESTING
WASTEWATER CHARACTERISTICS

PARAMETER	SHALLOW GROUND WATER			LEACHATE COMPOSITE		
	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM	MEAN
<u>BASE/NEUTRALS (ppb) Cont'd.</u>						
				2.0	71.0	34.5
Di-ethyl phthalate	0.0	10.2	1.7			
Di-n-butyl phthalate	0.0	11.0	3.5			
Di-n-octyl phthalate	0.0	0.0	0.0			
Isophorone	0.0	0.0	0.0			
Naphthalene	0.0	3.2	0.5			
N-nitrosodiphenyl amine	0.0	0.0	0.0			
<u>PESTICIDES/PCBs (ppb)</u>						
				0.0	0.0	0.0
<u>METAL (ppb)</u>						
				60.0	3180.0	700.0
Beryllium	0.0	2.0	0.3			
Cadmium	0.0	3.0	0.5			
Chromium	0.0	30.0	13.3			
Copper	10.0	40.0	20.0			
Lead	9.0	28.0	16.7			
Mercury	0.0	0.2	0.1			
Nickel	0.0	30.0	11.5			
Selenium	0.0	5.0	0.8			
Silver	0.0	10.0	4.8			
Thallium	0.0	5.0	1.7			
Zinc	0.0	240.0	78.3			
<u>MISCELLANEOUS (ppb)</u>						
Cyanides	0.0	0.0	0.0	0.0	47.0	24.0
Phenols	0.0	270.0	45.0	0.0	418.0	212.7



SOLUBILITIES OF METAL HYDROXIDES AS A FUNCTION OF pH

VII-13

SOURCE: USEPA, 1985. DEVELOPMENT DOCUMENT FOR EFFLUENT LIMITATIONS
GUIDELINES AND STANDARDS FOR THE METAL FINISHING POINT SOURCE
CATEGORY. EPA 440/1-85/001

GROUND WATER/LEACHATE TREATMENT
Alternative Process Schematics

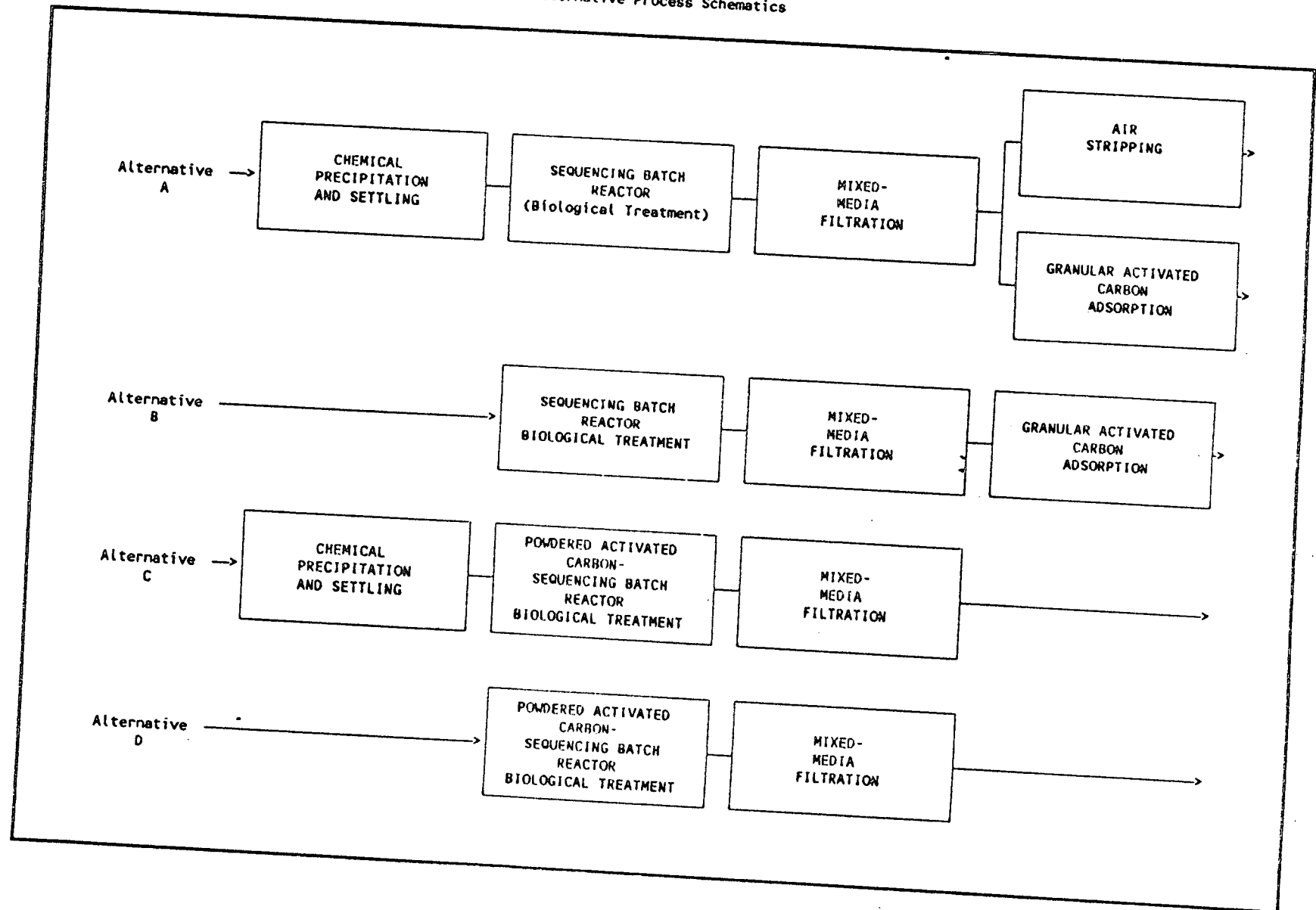


Figure 7